



## TORQUE TESTING M5 BOLTS

### **Purpose:**

To determine maximum torque that can be applied to Vallie Components Stainless M5 Torx bolts before failure of either threading, bolt body, or bolt head.

To determine the effect, if any, of thread lubrication on system strength.

To determine failure rate for threaded M5 holes in 6061 aluminum.

To determine maximum torque that can be applied to Black Oxide coated Avid disc rotor bolts and compare them to Vallie Components Stainless M5 bolts.





### **Materials used:**

1" square 6061 aluminum bar drilled every inch with M5x.8 threaded holes  
Torque wrench 10 ftlbs increments  
Fine torque wrench, 2Nm increments  
Camera  
25x Vallie components M5 stainless bolts  
10x Avid M5 black oxide coated M5 bolts  
bench vise  
Vallie Components prototype hub 001 on bicycle  
Vallie Components prototype cog  
2mm M5 washer  
Park T25 torx driver, ergonomic style  
Craftsman T25 torx bit, 3/8" drive  
BBB T25 torx bit, 1/4" drive  
Loctite242  
Phil Wood Bearing Grease

### **Procedure:**

First, the torque wrench will be used to test the torque supplied by the Park ergonomic T25 key on the Vallie Components Prototype hub 001.

Record findings for all 12 bolts, being careful not to add any additional torque to the bolts in use on the bicycle

A 1" square aluminum extrusion was created with M5x0.8 threaded holes every inch. There are 20 through holes in all, each is tapped from both sides.

The bolts will be installed under different conditions, with 5 samples of each to draw a mean torque from. The different conditions are:

5x full insertion dry  
5x full insertion lubed  
5x full insertion Loctite 242  
5x 7 threads insertion with Vallie components 15T cog dry  
5x 7 threads insertion with Vallie components 15T cog lubed  
5x avid supplied black oxide coated M5 bolts dry  
5x avid supplied black oxide coated M5 bolts dry with washer



Apply Loctite 242 to full insertion bolts first, and allow at least 10 hours drying time.

Do all bolts hand tight with Park T25 Key first, and ensure proper thread engagement.



**IMPORTANT: WEAR SAFETY GLASSES FOR THE FOLLOWING**

Align T25 bit collinearly with the bolt, and be sure to maintain pressure during torque wrench use.

Apply pressure with torque wrench, noting readings until bolt fails.

Record torque from wrench at the time of bolt failure



## Observations

NOTE: 1 ftlb = 1.356Nm

NOTE: Some initial testing was done with automotive torque wrench, before determining that finer scale wrench was required.

Actual Vallie Components Prototype hub 001 bolt torque, as applied by Park T25 Driver, checked with automotive torque wrench were found to be between 5 and 10 ftlbs. This test was not repeated with the BBB fine torque wrench.

Vallie bolt length: 11.52mm – 11.58mm

Thread count on Vallie bolt: 13 threads avg

Avid bolt length: 9.9mm, with 1.2mm shoulder

Thread count on Avid bolt: 9

Thread count on Vallie bolt through Vallie cog: 6.4mm or 7 complete threads

Thread count on Avid bolt through Vallie cog: NOT MEASURED

Thread count on Avid bolt through 2mm washer: 8

### 5x full insertion dry

- 1 Appeared to approach 10 ftlb before head sheared off (automotive wrench)
- 2 14Nm, sheared within 1 thread of bolt head
- 3 12Nm, sheared within 1 thread of bolt head
- 4 12Nm, sheared within 1 thread of bolt head
- 5 12Nm, sheared within 1 thread of bolt head



Bolt heads after dry full engagement test.

**5x full insertion lubed**

- 1 12Nm, sheared within 1 thread of bolt head
- 2 12Nm, sheared within 1 thread of bolt head
- 3 12Nm, sheared within 1 thread of bolt head
- 4 12Nm, sheared within 1 thread of bolt head
- 5 12Nm, sheared within 1 thread of bolt head

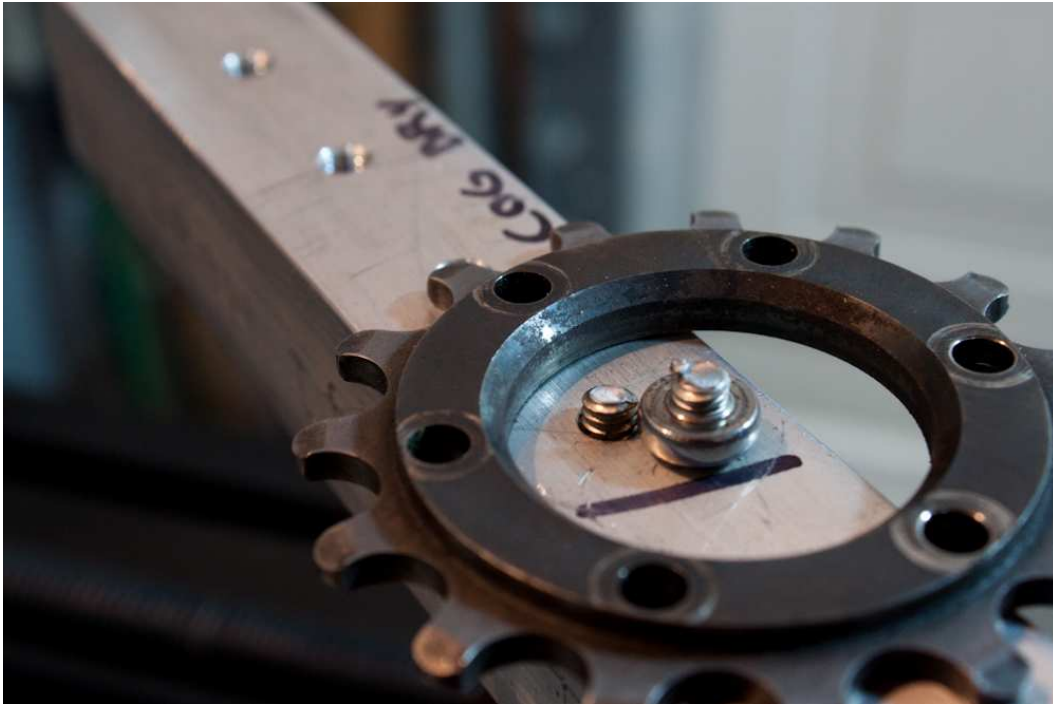
**5x full insertion locktite 242 (Applied over 48 hours before testing)**

- 1 13Nm, sheared within 1 thread of bolt head
- 2 14Nm, sheared within 1 thread of bolt head
- 3 12Nm, sheared within 1 thread of bolt head
- 4 12Nm, sheared within 1 thread of bolt head
- 5 13Nm, sheared within 1 thread of bolt head



**5x insertion with Vallie Components 15T cog dry**

- 1      Appeared to approach 10 ftlb before head sheared off (automotive wrench). Re-using hole and retrying with fine torque wrench, 10Nm, failed near bolt head
- 2      Failed at 10 Nm, 2 threads from bolt head
- 3      Failed at 10 Nm, 1 thread from bolt head, engagement felt fine at 9Nm
- 4      Failed at 11 Nm, 3 threads from bolt head. Tightened and loosened a couple of times at 8 Nm during test
- 5      Failed at 10 Nm, 1 thread from bolt head



Bolt failure is in area of threads that is able to stretch between cog face and 6061 face.



All remaining bolt studs were easily extracted with pliers.

**5x insertion with Vallie Components 15T cog lubed**

- 1 Failed at 10 Nm, 2 threads from bolt head
- 2 Failed at 10 Nm, 2 threads from bolt head
- 3 Failed at 10 Nm, 2 threads from bolt head
- 4 Failed at 10 Nm, 2 threads from bolt head
- 5 Failed at 10 Nm, 2 threads from bolt head

All remaining bolt studs were easily extracted with fingers only.

**5x avid supplied black oxide coated M5 bolts dry, burying shoulder into aluminum.** These bolts have a factory 'Loctite' type coating on the threads.

- 1 Appeared to approach 10 ftlb before head sheared off (automotive wrench)
- 2 13Nm failure, broke at shoulder
- 3 12Nm failure, broke at shoulder



- 4 13Nm failure, broke at shoulder
- 5 12Nm failure, broke at shoulder

**5x avid supplied black oxide coated M5 bolts, using 2mm washer to simulate similar thread engagement as previous Vallie Component bolt/cog tests**

- 1 12Nm failure, stripped threads from 6061 block
- 2 12Nm failure, 1 thread past shoulder. Too deep to remove
- 3 11Nm failure, 1 thread past shoulder. Too deep to remove
- 4 11Nm failure, 1 thread past shoulder. Too deep to remove
- 5 12Nm failure, 1 thread past shoulder. Too deep to remove





## Conclusions

Vallie Components stainless M5 Torx bolts, when inserted into 6061 Aluminum, through a Vallie Components 15T cog (thicker), failed at or above 10 Nm. We found that the bolt will fail at 10Nm 90% of the time. The result of all bolt failures, was that a threaded stud was left in the 6061 extrusion. In all cases, the remaining bolt studs were easily extracted from the extrusion. With only 7 threads engaged into the 6061, the material will hold to the point of bolt failure. In this case it is desirable to have the bolts fail before the 6061 aluminum of the hub shell.

It is not recommended to apply a torque greater than 8 Nm when tightening cog to Street fixed hub.

**Further testing will be required, with the second run of hubs, to determine acceptable minimum cog bolt torque after hubs have been anodized. Final torque spec subject to change.**

There appears to be no difference in maximum torque the Vallie Components bolts can handle between dry and lubed bolts. This implies that we are not getting 'false' torque readings due to friction on dry threads.

The Vallie Components bolts subjected to Loctite achieved a slightly greater average torque before failing. This may be a 'false' torque reading due to the friction of the cured Loctite. It should also be noted that the Avid bolts have a similar anti vibration coating on threads.

Avid black oxide coated rotor bolts are stronger on average than stainless Vallie Components bolts. This does not seem to be advantageous, as the bolts all failed in a manner that left them permanently installed in the 6061 Aluminum.

This is not a direct comparison, as the Avid bolts were shorter, and had a 1.2mm high shoulder from the head. It was expected that the Vallie bolts would fail before the Avid bolts.